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Abstract

THE USE OF BERYLLIUM AS A CANNING MATERIAL THE PROBLEMS ARISING FROM THE BRITTLENESS OF THE METAL AND THEIR PRESENT SOLUTION

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Beryllium has been considered as a canning material for reactors of the EL 4 type (CO_2 cooled, operating at 600°C). Two cases may be envisaged : either the can is not deformable under the exterior forces, but in this case a poor ductility may be tolerated, or else, the creep resistance is not sufficiently high ; the ductility should then be high at operating temperatures and also at room temperature for thermal cycling.

It became rapidly obvious that "ordinary" beryllium had not a sufficient creep resistance and it appeared difficult to increase it for EL 4 use (5 kg/mm^2). Other non-metallurgical factors also contributed to discard this approach. The second possibility was this considered and an attempt was made to increase the ductility of the metal which was for two low. The first objection was to determine to what extent this ductility depended on the purity.

It is not yet possible to say whether the brittleness at ordinary temperatures is due to some low concentration of a particular impurity. In the purest beryllium, which can be obtained by distillation vacuum fusion zone melting or a combination of these methods the critical shear stress of the two possible slip modes (0001) and $(10\bar{1}0)$ along $(11\bar{2}0)$ are even more different than in the less pure metal. This means that in the polycristal, the grains which can deform are those which are favourably oriented for basal slip and the fracture mode is still a cleavage along a basal plane. Neither from a theoretical nor a practical point of view has purification led to a solution to the problem of room-temperature brittleness.

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The lack of ductility observed around 600°C is undoubtedly due to the presence of impurities and inclusions (oxides). The solution is to use cast metal of industrial purity (or thermally treated in order to modify the impurity distribution) and to eliminate sintering as a production process.

Since, on the other hand, the intrinsic problem of the low-temperature brittleness was not solved, an attempt was made to overcome it by a stricter control of metallurgical factors. It has thus been possible to increase by a factor of 10 the low-temperature ductibility of tubes (of commercial purity beryllium or even of corrosion-resisting alloys).

This is sufficient for the present purpose. Experiments under way will show whether this is still true after exposure to significant irradiation doses.